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(54) **EQUIPMENT HANDLING APPARATUS**

(75) Inventors: **Michael Duane Metcalf**, Keaau, HI (US); **William Paul Rudisill Walker**, Pahoa, HI (US)

(73) Assignee: **WPRWMDM, L.L.C.**, Pahoa, HI (US)

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B60P 1/22	(2006.01)
A47F 5/00	(2006.01)
A47F 7/00	(2006.01)
F16M 11/00	(2006.01)
F16M 13/00	(2006.01)
B25B 1/22	(2006.01)

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(58) **Field of Classification Search** ..... 269/17, 269/71, 61, 1; 254/4 R, 4 B; 248/125.2, 248/125.7, 125.9
See application file for complete search history.

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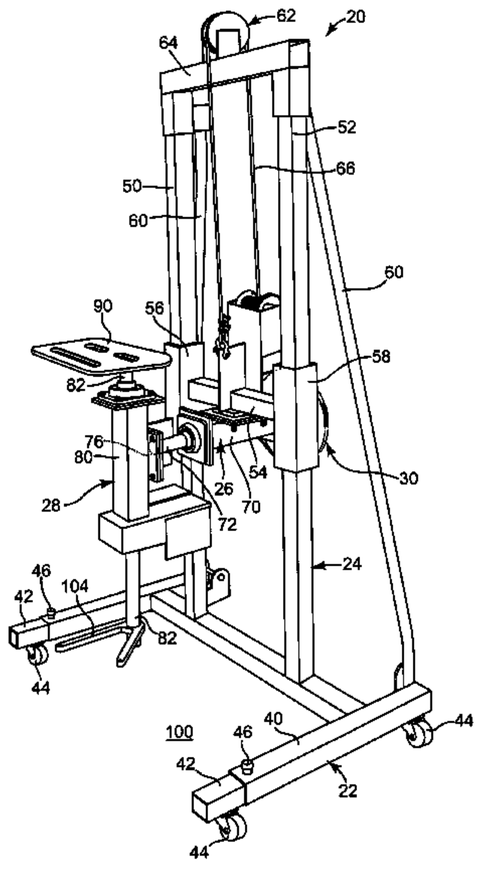
Primary Examiner—Joseph J. Hail, III
Assistant Examiner—Bryan R Muller
(74) *Attorney, Agent, or Firm*—Dicke, Billig & Czaja, P.L.L.C.

(57) **ABSTRACT**

An equipment handling apparatus is described. The equipment handling apparatus includes a base and a mast coupled to the base, an equipment head coupled to and translatable along the mast, and a mounting device rotatably coupled to the equipment head. In this regard, the mast is aligned along a first axis, and the equipment head includes a rotatable head shaft defining a second axis that is non-parallel to the first axis. The mounting device includes a second shaft independently rotatable about a third axis non-parallel to the second axis. The equipment handling apparatus provides for translating the equipment head, rotating the head shaft, and for rotating the second shaft independent of the head shaft.

23 Claims, 11 Drawing Sheets



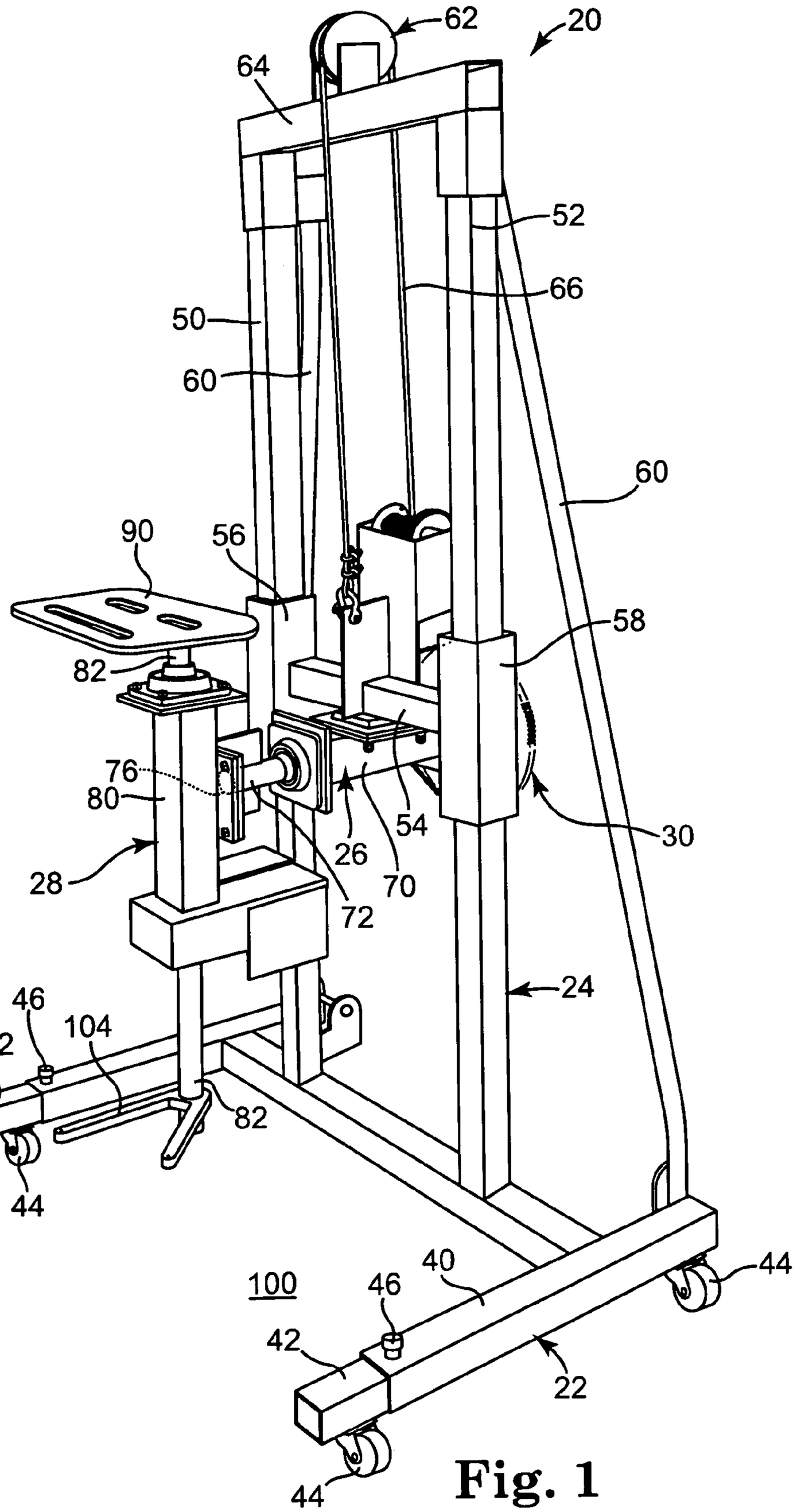

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Fig. 1

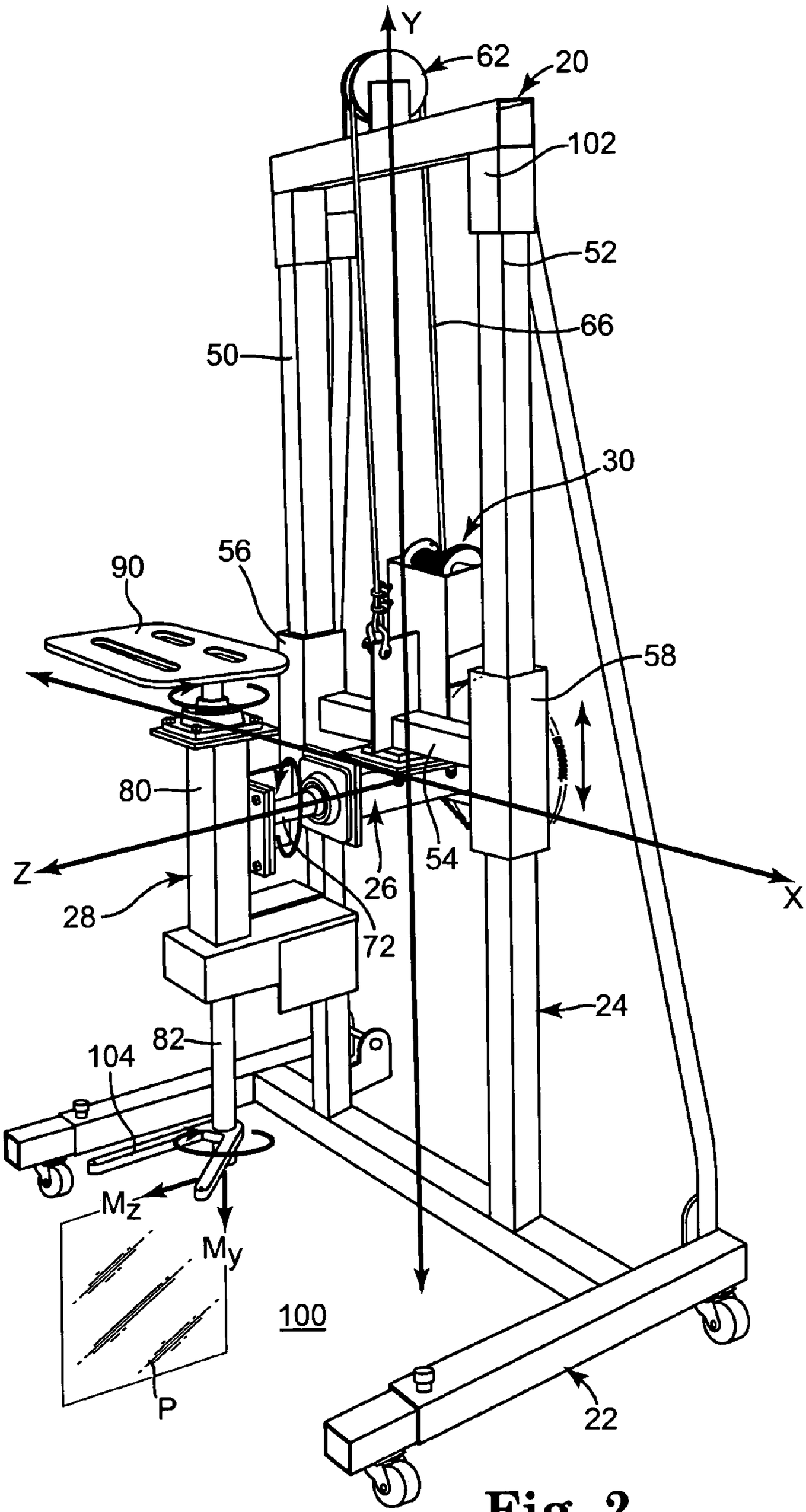
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Fig. 2

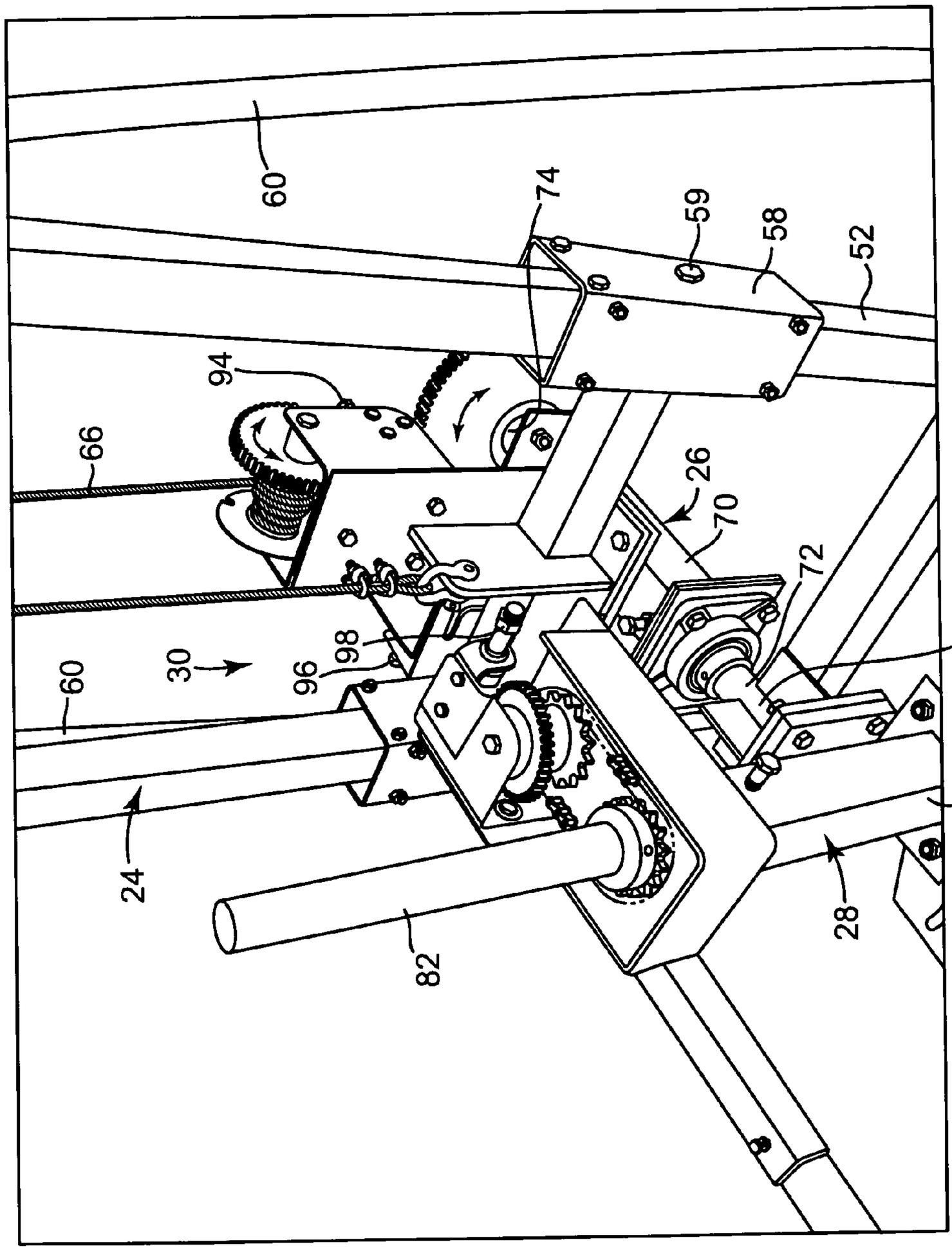

Fig. 3

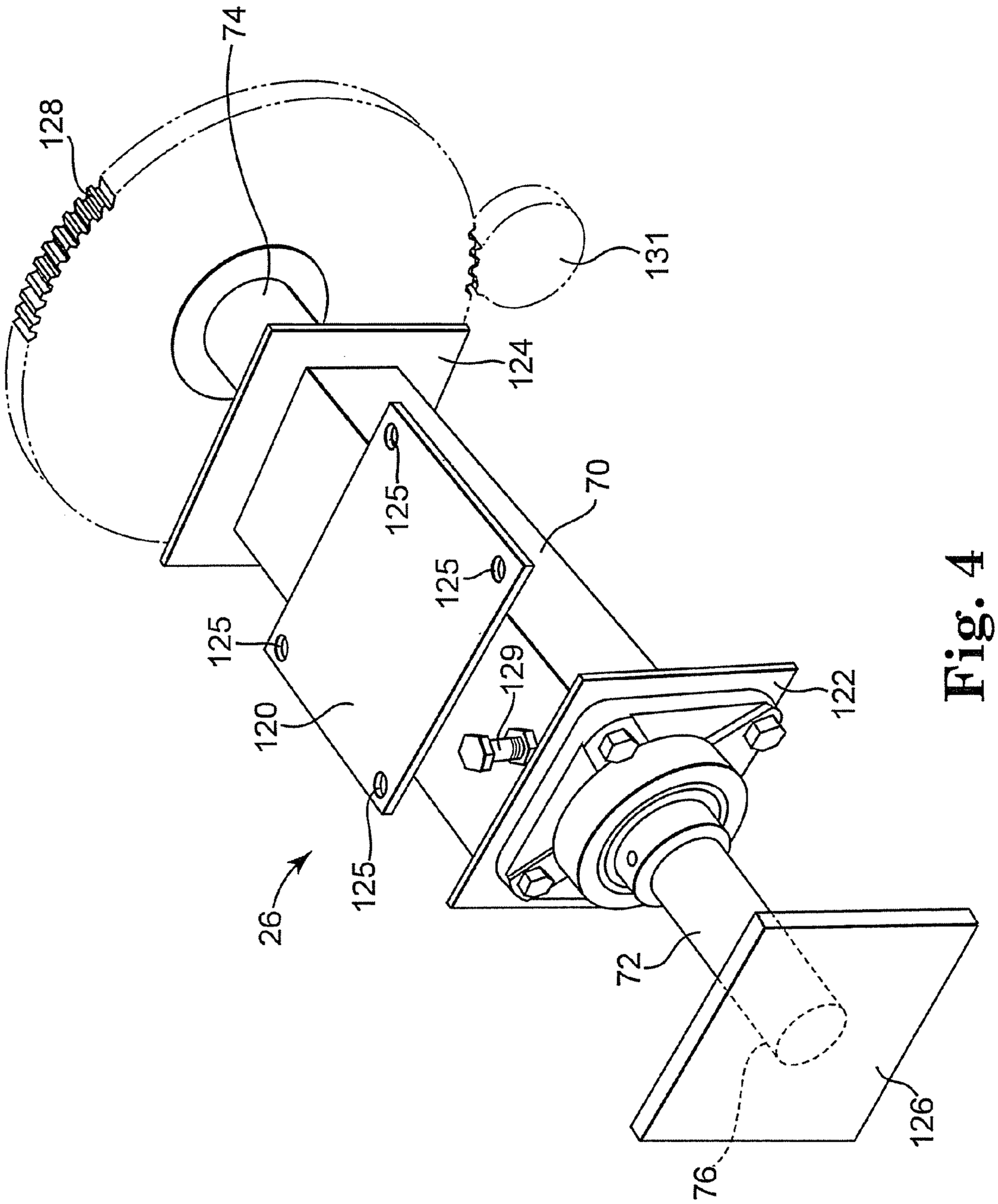

Fig. 4

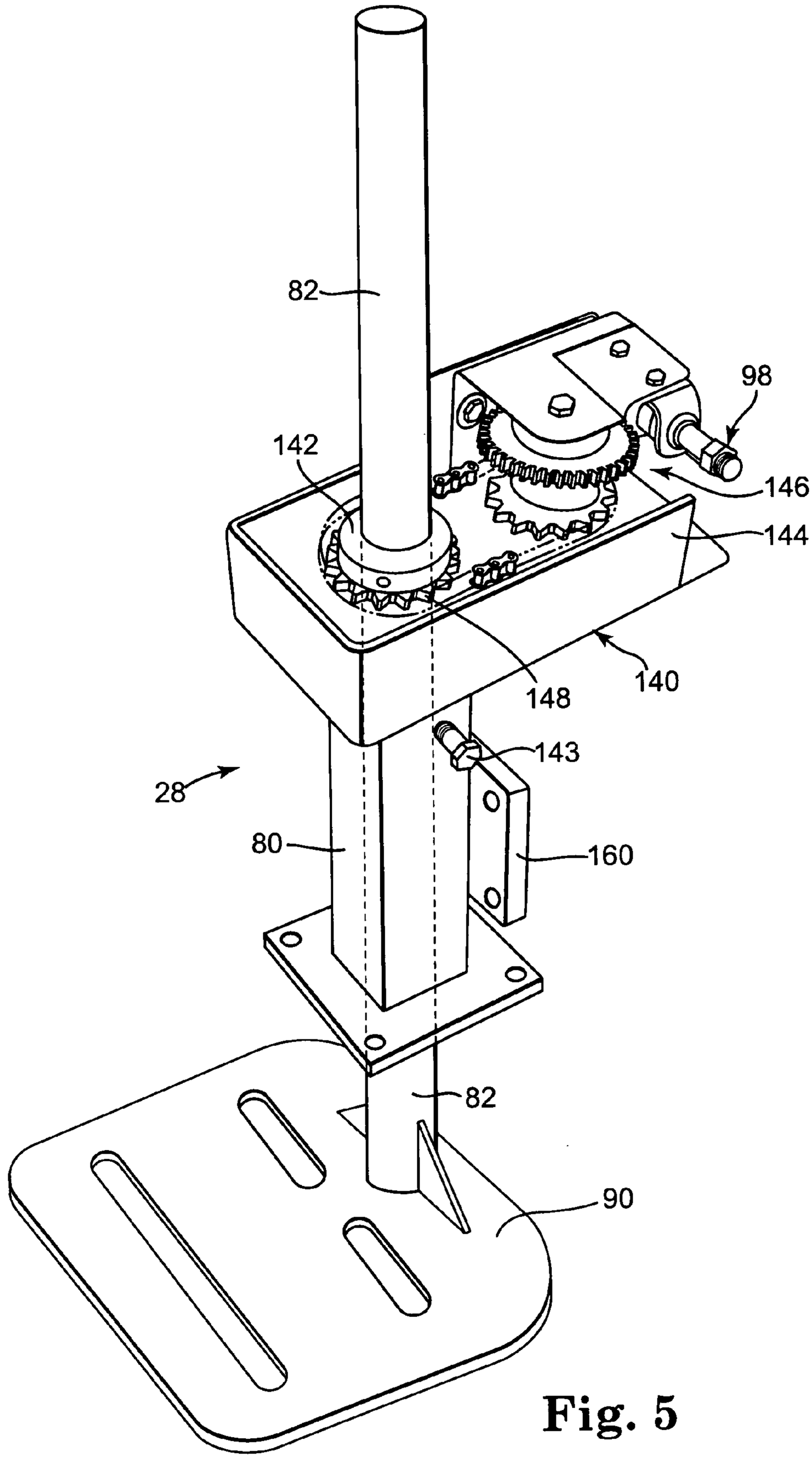

Fig. 5

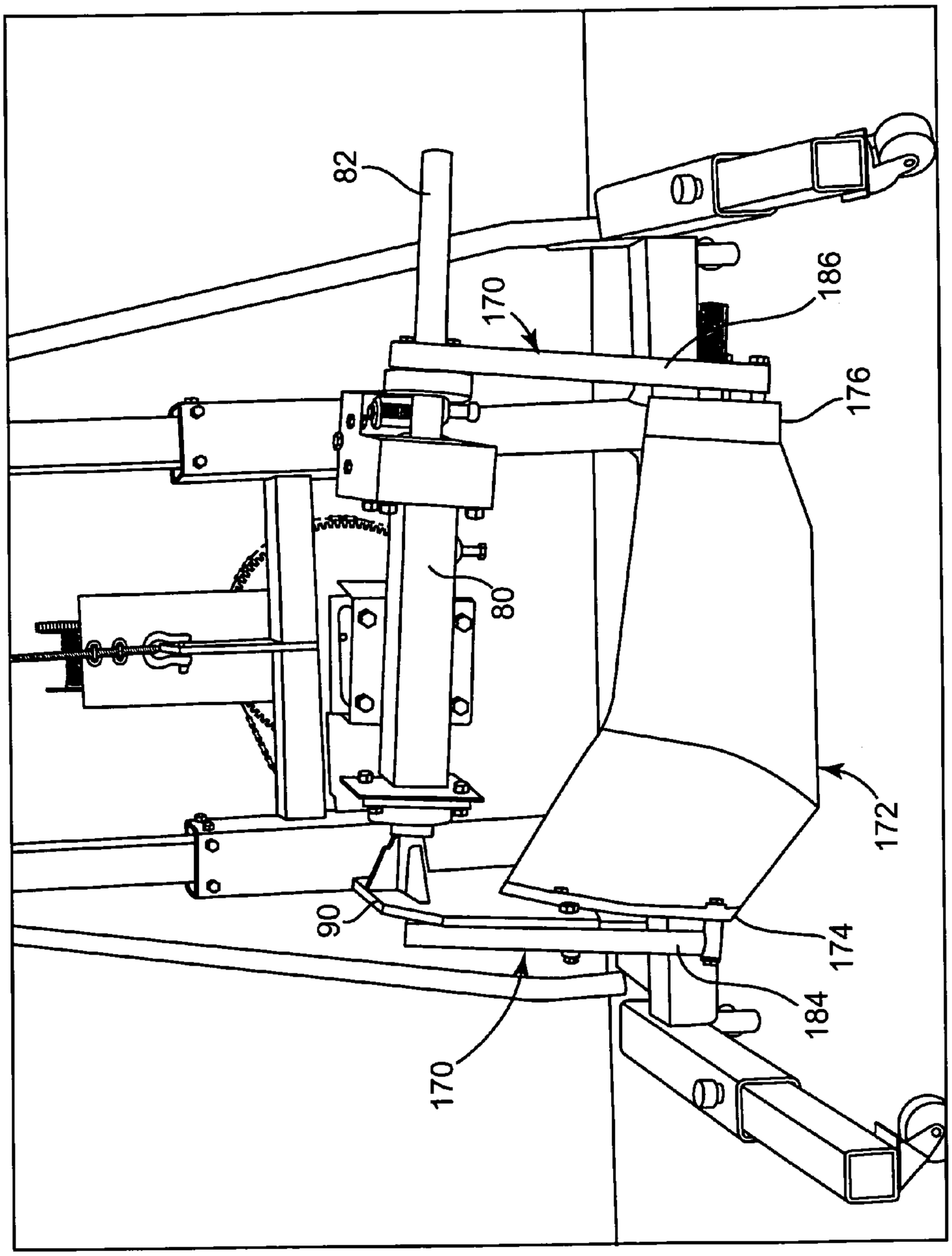

Fig. 6A

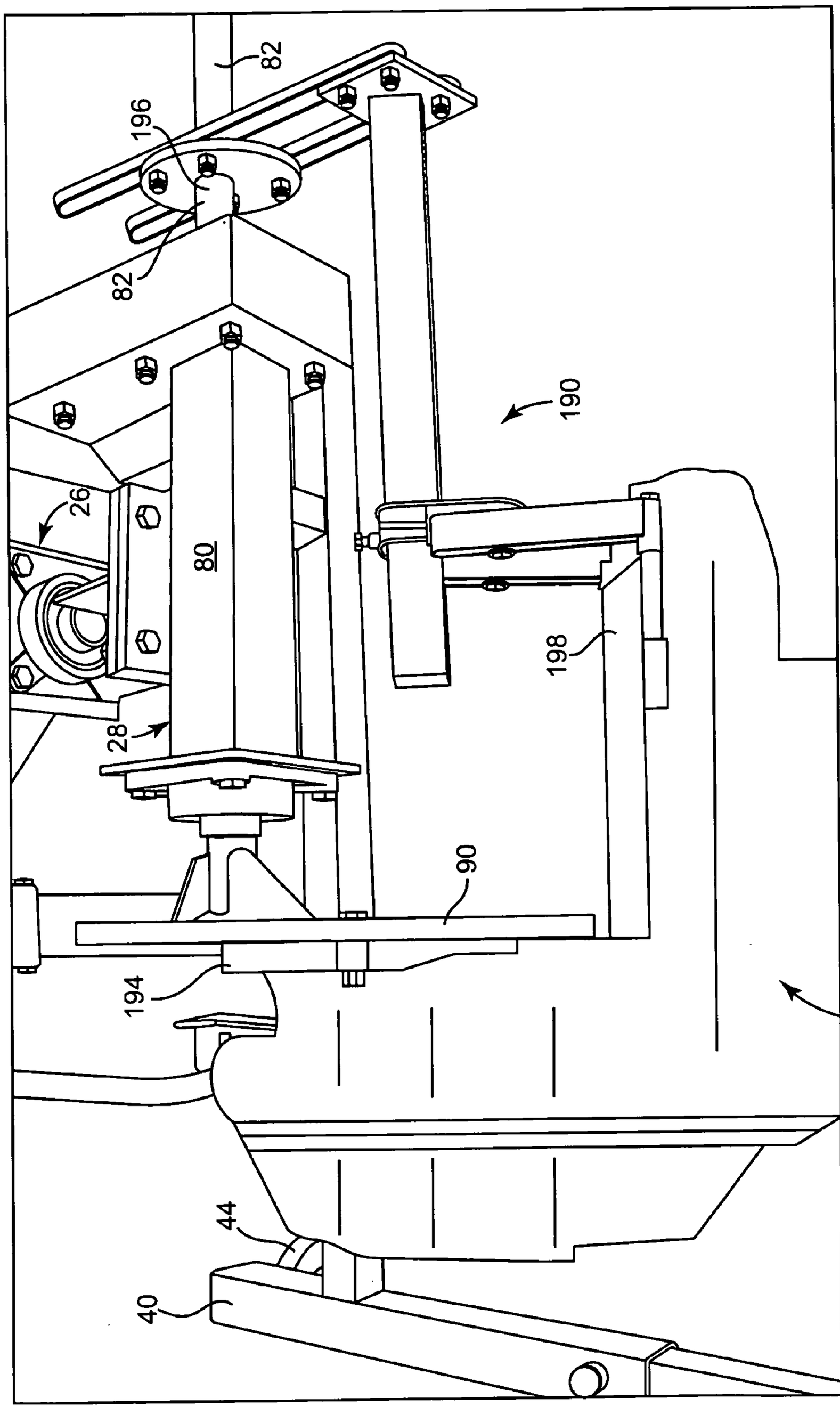

Fig. 6B

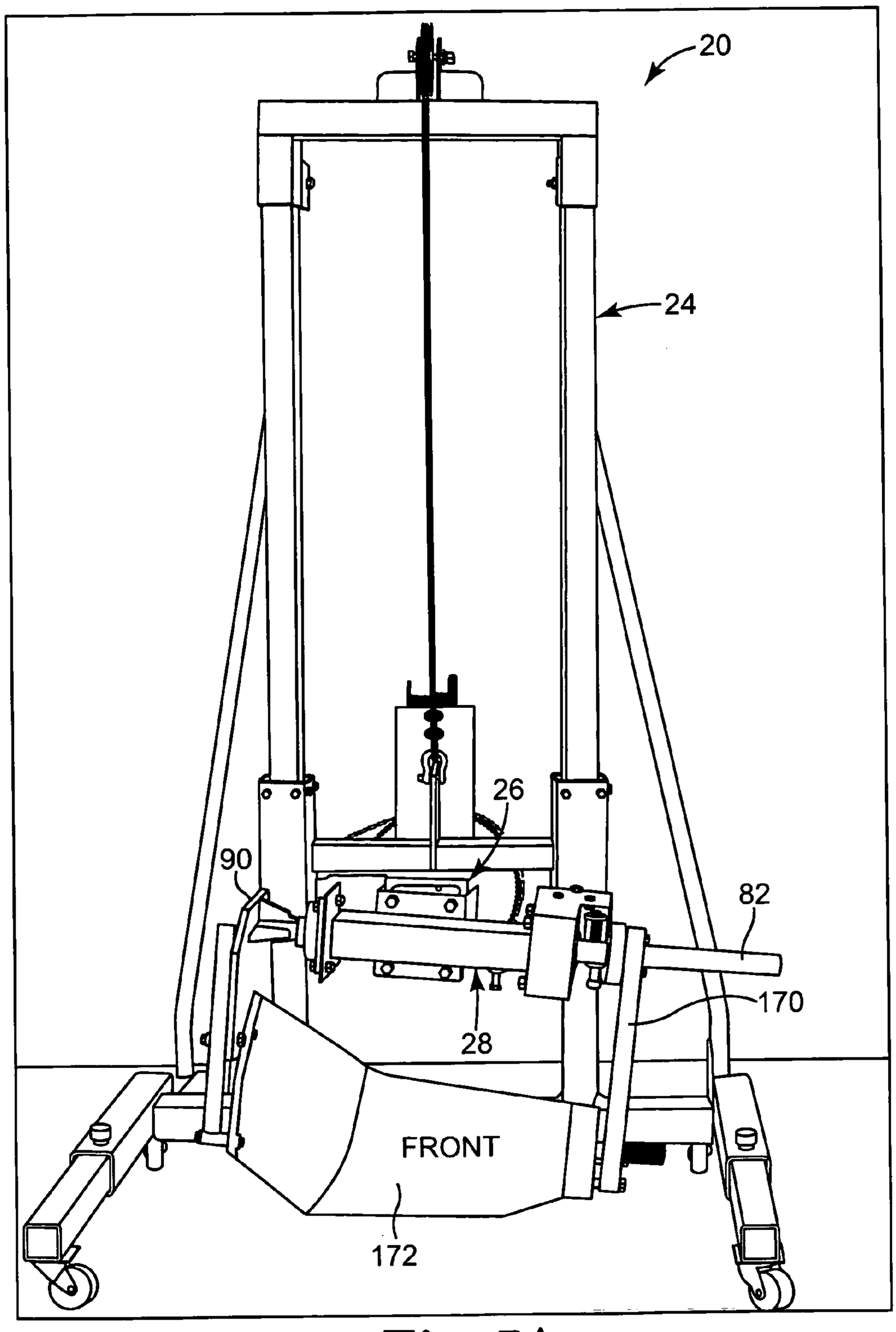

Fig. 7A

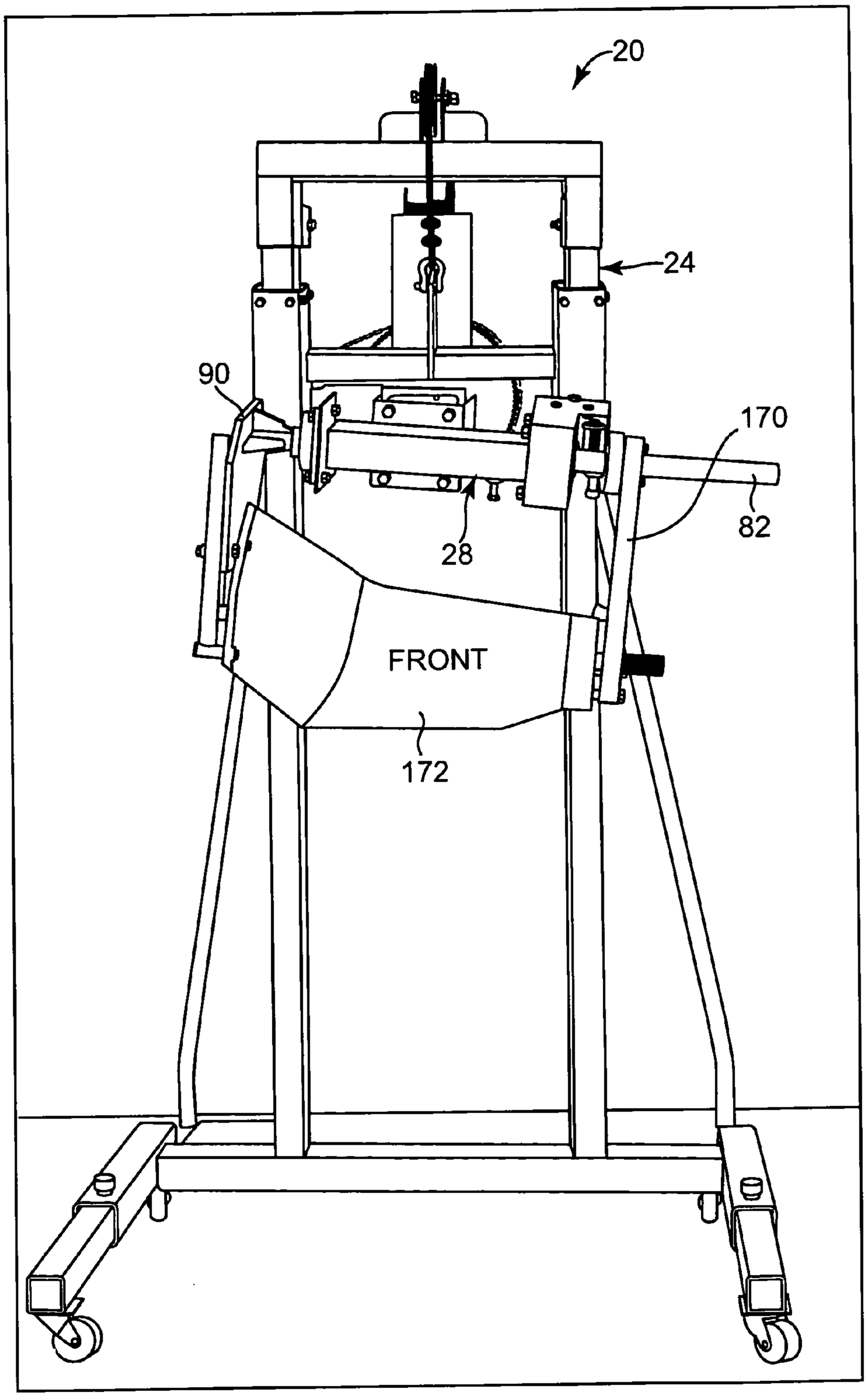

Fig. 7B

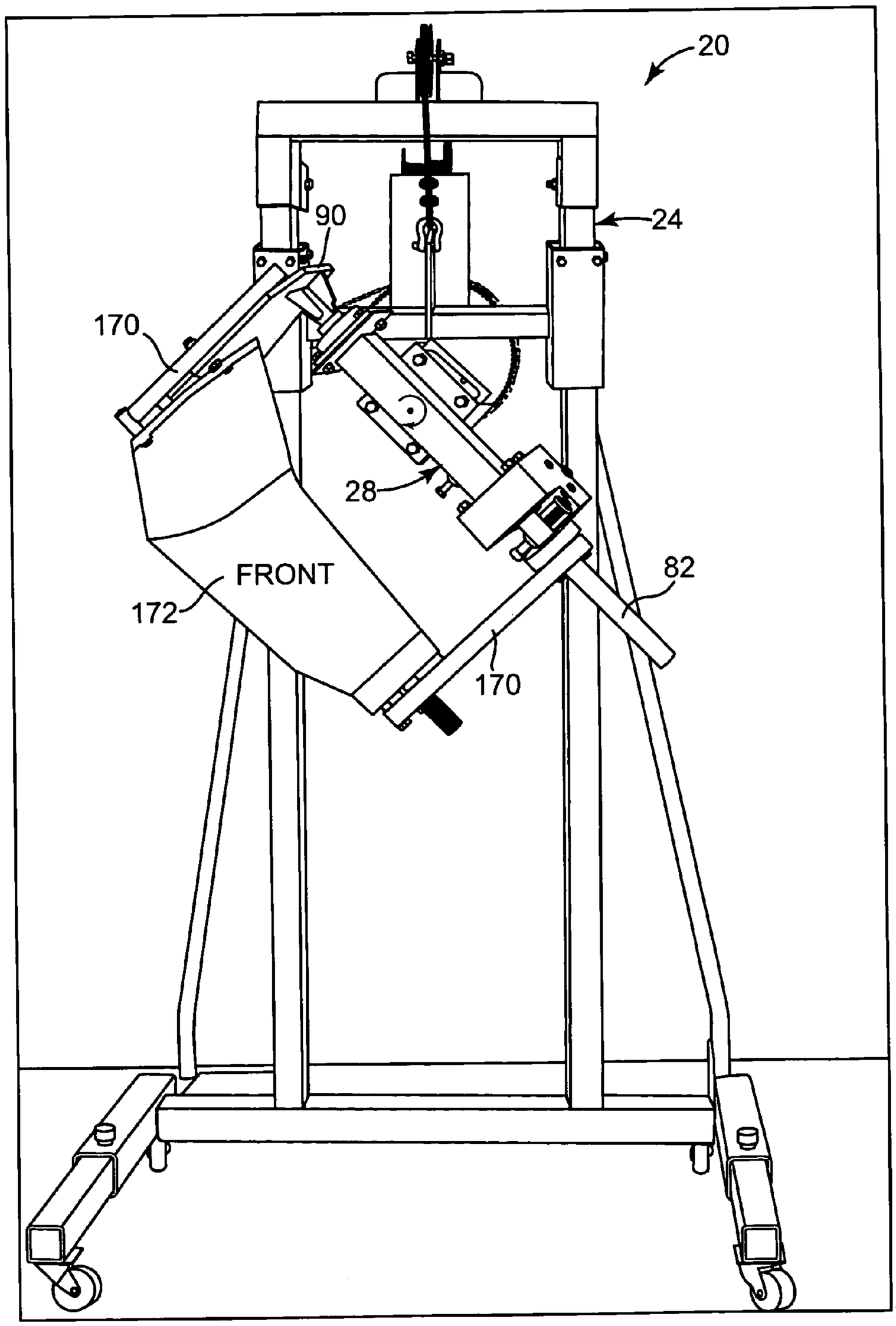

Fig. 7C

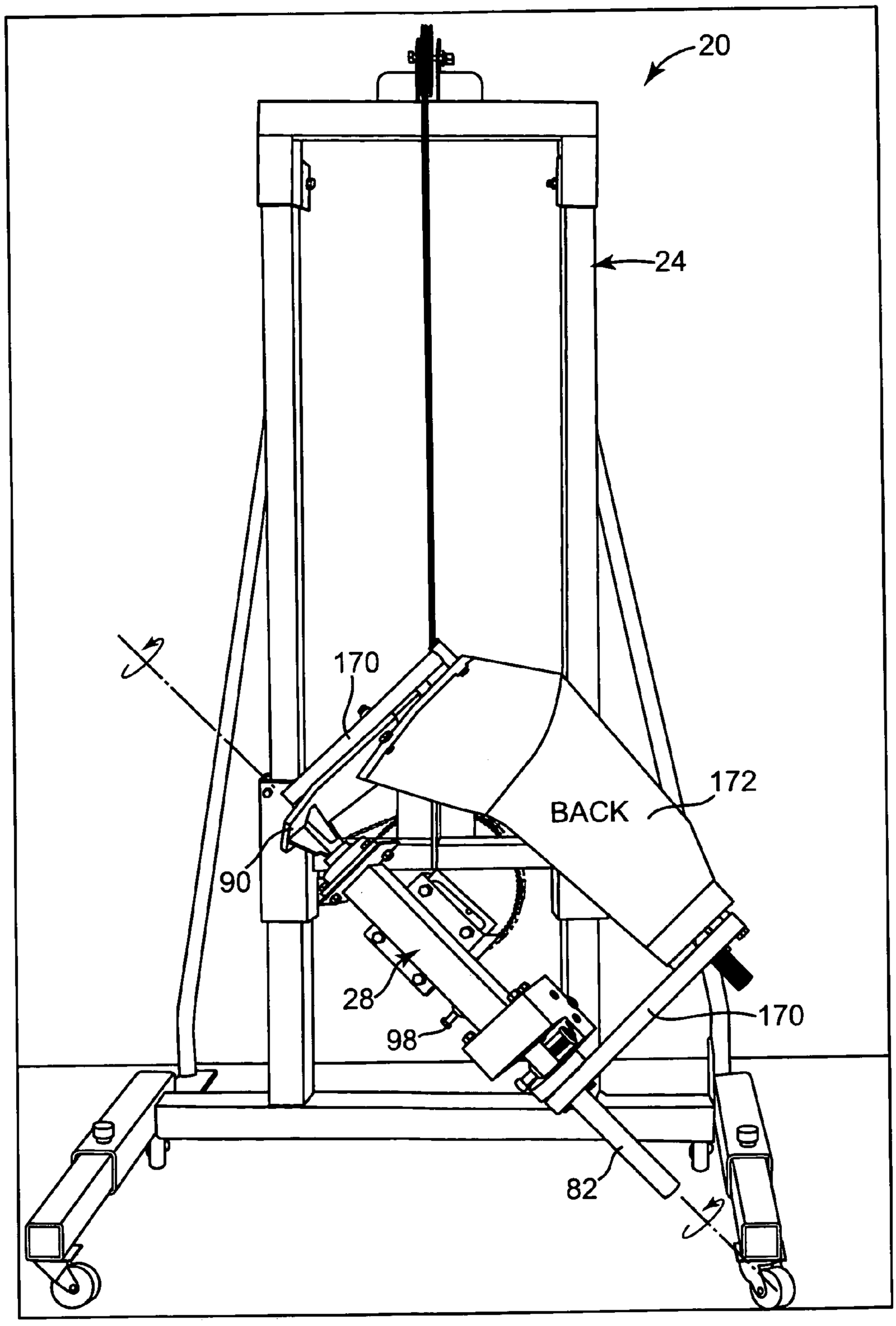

Fig. 7D

EQUIPMENT HANDLING APPARATUS

THE FIELD OF THE INVENTION

The present invention relates to equipment handling/repair stands, and more particularly, to equipment handling/repair stands useful in lifting an automotive part, rotating the automotive part about its centroid, and rotating the automotive part about its longitudinal and lateral axes.

BACKGROUND

Equipment handling/repair stands have proven useful to original equipment and automobile manufacturers, as well as to independent mechanics active in the repair of automobiles and industrial equipment. In general, an equipment handling/repair stand provides access to equipment in need of repair or maintenance and includes a base, a support extending from the base, and an equipment mount coupled to the support. During use, a piece of equipment, such as an automotive engine or transmission, is lifted in place and bolted to the equipment mount. A hoist or other lifting device is employed to lift especially heavy parts up to the equipment mount portion of the equipment stand. In other cases, two or more people lift, hold, and support an automotive part until the part is secured to the equipment mount. Those with experience in using such equipment handling/repair stands understand that care must be taken to avoid bodily injury that can occur in the lifting, or in the accidental dropping, of the part during the mounting process.

Equipment handling/repair stands maintain and support the automotive part for access by a mechanic. Some equipment stands permit the automotive part to be rotated about the support. For example, one known equipment stand is useful for supporting a boat motor. The boat motor is attached to a horizontal equipment mount coupled to a vertical support of the stand. The vertical support can be rotated for improved access to the boat motor housing, or rotated for access to the boat motor prop. However, the range of motion of the vertical support is limited, and the horizontal equipment mount obstructs access to the boat motor housing.

Equipment stands are useful for supporting the weight of automotive parts such as engines and transmissions, and permit a mechanic to work on, and safely and conveniently access, the part. However, the known equipment stands have the disadvantage of requiring at least one person, and often two people, to lift the automotive part up to a horizontal equipment mount portion in attaching the automotive part to the equipment stand. In addition, even after the automotive part is attached to the equipment stand, the equipment mount portion obstructs access to at least a portion of the automotive part. Moreover, during use, the known equipment stands fail to provide complete access to all surfaces of the automotive part. With this in mind, improvements to equipment stands would be welcomed by original equipment manufacturers and independent mechanics.

SUMMARY

One aspect of the present invention relates to an equipment handling apparatus. The equipment handling apparatus includes a base and a mast coupled to the base, an equipment head coupled to and translatable along the mast, and a mounting device rotatably coupled to the equipment head. In this regard, the mast is aligned along a first axis, and the equipment head includes a rotatable head shaft defining a second axis that is non-parallel to the first axis. The mounting device includes a second shaft independently rotatable about a third axis non-parallel to the second axis. Motive means provide for translating the equipment head, rotating the head shaft, and for rotating the second shaft independent of the head shaft.

Another aspect of the present invention relates to an equipment repair stand. The equipment repair stand includes a base and a substantially vertical mast coupled to the base, an equipment head coupled to the mast, and a mounting device coupled to the equipment head. In this regard, means for translating the equipment head along the mast, and means for rotating a first shaft extending from the equipment head, and means for rotating a second shaft extending from the mounting device independent of the first shaft is provided.

Yet another aspect of the present invention relates to a method of handling a work piece. The method includes attaching the work piece to an equipment stand and lifting the work piece along a first axis. The method additionally provides rotating the work piece about a second axis. The method further provides rotating the work piece about a third axis.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention are better understood with reference to the following drawings. The elements of the drawings are not necessarily to scale relative to each other. Like reference numerals designate corresponding similar parts.

FIG. **1** illustrates a perspective view of an equipment handling apparatus according to one embodiment of the present invention.

FIG. **2** illustrates a free body diagram of an equipment handling apparatus including a coordinate system superimposed over the equipment handling apparatus according to one embodiment of the present invention.

FIG. **3** illustrates an equipment head of the equipment handling apparatus illustrated in FIG. **1**, and a mounting device coupled to the equipment head according to one embodiment of the present invention.

FIG. **4** illustrates an equipment head according to one embodiment of the present invention.

FIG. **5** illustrates a mounting device according to one embodiment of the present invention.

FIG. **6**A illustrates an equipment mount coupled to the equipment handling apparatus illustrated in FIG. **1** according to one embodiment of the present invention.

FIG. **6**B illustrates another equipment mount coupled to the equipment handling apparatus illustrated in FIG. **1** according to one embodiment of the present invention.

FIG. **7**A illustrates an equipment stand including an equipment mount coupled to a transmission at rest on a floor according to one embodiment of the present invention.

FIG. **7**B illustrates the equipment stand of FIG. **7**A lifting the transmission above the floor according to one embodiment of the present invention.

FIG. **7**C illustrates the equipment stand of FIG. **7**B showing the transmission rotated about an equipment head axis.

FIG. **7**D illustrates the equipment stand of FIG. **7**C showing the transmission rotated out of the plane of the illustration about a mounting device axis.

DETAILED DESCRIPTION

In the following Detailed Description, reference is made to the accompanying drawings, which form a part hereof, and in which is shown by way of illustration specific embodiments in which the invention may be practiced. In this regard, direc-

tional terminology, such as "top," "bottom," "front," "back," "leading," "trailing," etc., is used with reference to the orientation of the Figure(s) being described. Because components of embodiments of the present invention can be positioned in a number of different orientations, the directional terminology is used for purposes of illustration and is in no way limiting. It is to be understood that other embodiments may be utilized and structural or logical changes may be made without departing from the scope of the present invention. The following detailed description, therefore, is not to be taken in a limiting sense, and the scope of the present invention is defined by the appended claims.

FIG. **1** illustrates an equipment handling apparatus **20** according to one embodiment of the present invention. The equipment handling apparatus **20** (or stand **20**) includes a base **22** and a mast **24** coupled to the base **22**, an equipment head **26**, a rotatable mounting device **28** coupled to the equipment head **26**, and motive means **30** for translating and rotating the equipment head **26**, and for rotating the mounting device **28** relative to the equipment head **26**.

Base **22** generally provides a supporting foundation for mast **24**. In one embodiment, base **22** is rigidly mounted to a floor, for example a floor in an auto repair shop bay, such that base **22** is substantially immovable and mast **24** is stationary. In another embodiment, base **22** includes a frame **40**, and a pair of legs **42** extending from frame **40**. In one embodiment, wheels **44** are coupled to frame **40** such that base **22** is transportable (i.e., movable along a floor). Wheels **44** include free rolling wheels, or alternately, locking wheels. The extendable legs **42** telescope out of frame **40** to permit an adjustment (an increase or a decrease) in a "footprint" of base **22** to enable adjustment of a secure foundation for stand **20**. In one embodiment, legs **42** are lockable relative to frame **40** by bolts **46**, such that after legs **42** are telescoped into or out of frame **40**, bolts **46** are "locked" down onto legs **42** through frame **40** to selectively lock legs **42** in a desired position.

Mast **24** extends from base **22** and is generally aligned along a first axis. For example, in one embodiment mast **24** is a vertical mast aligned along a substantially vertical axis, as illustrated in FIG. **1**. In one embodiment, mast **24** includes a first support member **50** and a second opposing support member **52**, and a brace **54** extending between the opposing support members **50**, **52**. Brace **54** is slideable along support members **50**, **52** to provide adjustment for equipment head **26** along the first axis, and in one embodiment brace **54** includes a first collar **56** coupled about support **50** and a second collar **58** coupled about support **52**. In one embodiment, at least one of the collars **56**, **58** is lockable relative to a respective support member **50**, **52**, for example, as best shown in FIG. **3** where locking bolt **59** locks collar **58** to support member **52**.

Mast **24** optionally includes reinforcing members **60** extending to frame **40**. It is to be understood that reinforcing members **60** are optional when stand **20** is rigidly mounted to a floor. Those with skill in the equipment stand art will also appreciate that a single support could be employed in place of support members **50**, **52**, or alternately, three or more support members could be utilized in place of support members **50**, **52**.

In addition, mast **24** includes in one embodiment a winch device **62** coupled to a fixed top brace **64** and provides a cable **66** extending to movable brace **54**. In this manner, winch device **62** is adapted to move brace **54**, and thus equipment head **26**, along support members **50**, **52** in adjusting a position of equipment head **26** along the first axis (for example, in adjusting a vertical position of equipment head **26** relative to mast **24**). Thus, in one embodiment winch device **62** translates brace **54**/equipment head **26** along mast **24**.

In one embodiment, and with additional reference to FIG. **3**, equipment head **26** includes a head housing **70** maintaining a rotatable head shaft **72**. Generally, equipment head **26** is attached to brace **54**, and head shaft **72** is rotatable within equipment head **26**. One aspect of the invention provides head shaft **72** including a gear end **74** and flange end **76**, where gear end **74** is coupled to a movement means (such as a viscous drive or a direct gear drive) for rotating head shaft **72**, and flange end **76** is coupled to mounting device **28** and adapted to rotate mounting device **28** relative to equipment head **26**.

In one embodiment, and with additional reference to FIG. **4**, mounting device **28** includes an adaptor shaft housing **80** coupled to flange end **76** of head shaft **72**, and a rotatable adaptor shaft **82** extending from adaptor shaft housing **80**. In this regard, a rotation of head shaft **72** rotates mounting device **28**, and adaptor shaft **82** is independently rotatable within mounting device **28** by at least 180 degrees relative to the flange end **76**. Thus, mounting device **28** rotates relative to equipment head **26**, and adaptor shaft **82** rotates within mounting device **28** such that adaptor shaft **82** is independently rotatable relative to equipment head **26**.

Referring to FIG. **1**, in one embodiment, mounting device **28** includes an equipment mount **90** and an equipment mount adaptor **104** coupled to opposing sides of rotatable adaptor shaft **82**. Equipment mount **90** is configured to couple to a variety of parts/work pieces such as, for example, large truck transmissions, small front wheel drive transmissions, automotive engines, or any automotive or truck part. Equipment mount adaptor **104** couples to an opposing side of the parts/work pieces. By the rotations of the components described above, the parts/equipment coupled to equipment mount **90**/equipment mount adaptor **104** can be moved and selectively maintained in useful orientations for maintenance and repair. For example, in one embodiment, head shaft **72** and adaptor shaft **82** are each selectively lockable to a non-rotating state (for example, via collars, or chucks, or locking nuts) such that an orientation of the mounting device **28** relative to equipment head **26**, and an orientation of the parts/equipment coupled to equipment mount **90** can be selectively adjusted and maintained.

Motive means **30** (FIG. **1**) generally comprises a plurality of gears and shafts coupled variously to mast **24**, equipment head **26**, and mounting device **28**. In one embodiment, and with additional reference to FIG. **3**, motive means **30** includes a plurality of drives, including a winch drive **94** coupled to winch device **62**, an equipment head drive **96** coupled to equipment head **26**, and a mounting device drive **98** coupled to mounting device **28**.

In one embodiment, each of the drives **94**, **96**, **98** is engageable and operable by a portable device, such as an electric hand drill, or a manual crank. For example, in one embodiment each of the drives **94**, **96**, **98** is a 0.5 inch drive suited for rotation by an electric hand drill (for example, an 18-volt hand drill), although other sizes for mounting device drives **94**, **96**, **98** are also acceptable. In another embodiment, motive means **30** includes a dedicated device such as an air-assisted drive or a motor engageable with air drives and couplings suited for rotating head shaft **72** and/or mounting device **28** and adaptor shaft **82**. In any regard, motive means **30** translates and rotates head shaft **72**, and rotates mounting device **28** relative to the equipment head **26** to provide safe, convenient and unfettered access to parts/equipment supported by equipment mount **90** from device **20**.

FIG. **2** illustrates the equipment handling apparatus **20** including an X-Y-Z coordinate reference system superimposed over the apparatus **20** and useful in describing relative motions between components according to one embodiment

of the present invention. Mast **24** extends from base **22** and is generally aligned along a first axis, for example the Y-axis. In one embodiment, mast **24** is a vertical mast and base **22** is a horizontal base such that mast **24** is perpendicular to base **22**. However, it is to be understood that mast **24** can be oriented relative to base **22** in a variety of orientations and that the Y-axis is generally aligned with mast **24**.

Head shaft **72** of equipment head **26** is rotatable relative to mast **24**, and equipment head **26** is also translatable along mast **24** (along the Y-axis) from a position adjacent to floor **100** to a top of the mast to top **102** of mast **24**. For example, in one embodiment winch device **62** translates equipment head **26** along mast **24** such that collars **56**, **58** slide along support members **50**, **52**, respectively.

With this in mind, head shaft **72** of equipment head **26** is generally aligned along a second axis, which is non-parallel to the Y-axis. In one embodiment, and as illustrated in FIG. **2**, head shaft **72** is aligned with the Z-axis and is perpendicular to the Y-axis. However, it is to be understood that the head shaft **72** can be oriented relative to the Y-axis in any manner, and in the general case, head shaft **72** is oriented non-parallel to the Y-axis.

Head shaft **72** of equipment head **26** is rotatable by 360 degrees about its axis. Head shaft **72** is coupled to mounting device **28** such that mounting device **28** also rotates by 360 degrees about the axis of head shaft **72** (i.e., the Z-axis of FIG. **2**), and mounting device **28** includes an independently rotatable adaptor shaft **82**. With the above coordinate system in mind, mounting device **28** is rotated by head shaft **72**, and equipment (not shown) coupled to an equipment mount adaptor **104** is further rotated by adaptor shaft **82** such that the equipment can be translated along the Y-axis, rotated (via shaft **72**) about the Z-axis, and rotated (via shaft **82**) about a third axis (defined by adaptor shaft **82**) non-parallel to the Z-axis.

For example, adaptor shaft **82** extends from adaptor shaft housing **80** and for descriptive purposes, defines axis M_y as shown in FIG. **2**. An axis M_z, is shown substantially perpendicular to adaptor shaft **82** axis M_y. Since adaptor shaft **82** is rotatable about its axis M_y, the orientation of axis M_z, rotates about axis M_y, With this in mind, a plane P is defined by M_y and M_z. Thus, in the orientation of FIG. **2**, plane P is parallel to and coincident with vertical plane Y-Z.

However, since adaptor shaft **82** is rotatable, plane P can be rotated about M_y to be parallel to the plane formed by the X-axis and the Y-axis, and since head shaft **72** is rotatable about the Z-axis, plane P can be rotated to be parallel to the plane formed by the X-axis and the Z-axis, and by a combination of rotations of head shaft **72** and adaptor shaft **82**, plane P can be rotated to any orientation relative to any of the horizontal planes (for example, the X-Z plane) and vertical planes (for example, the X-Y and the Y-Z planes).

In one embodiment, head shaft **72** is substantially aligned with the Z-axis and substantially perpendicular to mast **24** (and the Y-axis), and adaptor shaft **82** (and thus axis M_y) of mounting device **28** is substantially perpendicular to equipment head **26**. In another embodiment, shaft **72** is not perpendicular to mast **24**, and shaft **82** is not perpendicular to equipment head **26**. In all embodiments, and as described above, equipment head **26** can be translated up and down mast **24**, head shaft **72** is rotatable **360** degrees about its axis, and mounting device **28** includes an adaptor shaft **82** that is independently rotatable relative head shaft **72** such that adaptor shaft **82** is rotatable about a third axis (the M_y axis). In this manner, equipment head **26** is translatable and rotatable, and mounting device **28** rotates relative to equipment head **26**.

FIG. **3** illustrates equipment head **26** coupled with mounting device **28** according to one embodiment of the present invention. In one embodiment, equipment head **26** is rigidly mounted to movable brace **54**. Rotatable head shaft **72** couples with mounting device **28** such that mounting device **28** is rotated by head shaft **72** when equipment head drive **96** is driven/turned. Mounting device **28** includes adaptor shaft **82**, where adaptor shaft **82** is independently rotatable from head shaft **72**.

While adaptor shaft **82** is rotatable by 360 degrees about its axis, in use, adaptor shaft **82** rotates at least 180 degrees (but somewhat less than 360 degrees). For example, adaptor shaft **82** is limited in rotation when equipment extending from equipment mount **90** (FIG. **1**) rotates into equipment head **26**. Thus, mounting device **28** is rotatable in a full circle (360 degrees) and adaptor shaft **82** is rotatable up to approximately 360 degrees, depending upon the particular configuration of the equipment/work piece being worked on.

FIG. **4** illustrates an equipment head **26** according to one embodiment of the present invention. Equipment head **26** includes head housing **70** that defines an attachment plate **120** and opposing sealed couplings **122**, **124** that seal about and maintain rotatable head shaft **72**. Plate **120** is attachable to brace **54** (FIG. **1**), and includes bolt holes **125**. In one embodiment, bolts (not shown) are inserted through bolt holes **125** to bolt plate **120** to brace **54**. In an alternate embodiment, head housing **70** is welded to brace **54**. Head shaft **72** extends from head housing **70**, through sealed couplings **122**, **124**, and includes a flange **126** at flange end **76**, and a gear **128** at gear end **74**. In one embodiment, a shaft lock **129** is provided on head housing **70** and configured to adjust between an unlocked position and a locked position, where the locked position secures shaft **72** in a non-rotatable state.

In one embodiment, flange **126** is configured to bolt to flange **160** (See FIG. **5**) such that equipment head **26** is coupled to mounting device **28**. In this regard, turning equipment head drive turns gear **128** (i.e., a head gear) that rotates head shaft **72** such that flange **126** also rotates and turns mounting device **28**. To ensure an appropriate level of torque delivery between equipment head drive and head shaft **72**, in one embodiment gear **128** defines an 82-tooth gear that is coupled to a 21-tooth drive sprocket **131**, although other numbers of teeth between gear **128** and the drive sprocket **131** are also acceptable. For example, in one embodiment gear **128** and the gear of drive sprocket **131** define a gear ratio of between 1:1 to 10:1, although other gear ratios for gear **128** and drive sprocket **131** are also acceptable, depending upon a selected or desired level of torque at head drive.

FIG. **5** illustrates mounting device **28** according to one embodiment of the present invention. Mounting device **28** includes adaptor shaft housing **80**, a drive assembly **140** including a sealed coupling **142**, and adaptor shaft **82** that extends along housing **80** and through drive assembly **140** and sealed coupling **142**. In one embodiment, a shaft lock **143** is provided on housing **80** and configured to adjust between an unlocked position and a locked position, where the locked position secures adaptor shaft **82** in a non-rotatable state.

In one embodiment, drive assembly **140** includes a gear box **144** housing a plurality of gears **146**, and mounting device drive **98** coupled to gears **146**. Mounting device drive **98** is coupled to the plurality of gears **146** (at least one of which is an equipment mount gear **148** suited to rotate shaft **82**) and is configured to drive adaptor shaft **82**.

When mounting device drive **98** is rotated, the plurality of gears **146** operates to turn adaptor shaft **82**. In one embodiment, gears **146** define a gear ratio such that one turn of the mounting device drive **98** correlates to a fraction of a turn of

adaptor shaft **82**. Thus, gears define a gear ratio of between, for example, 1:1 to 10:1, although other gear ratios are also acceptable. Those with experience in the selection of gears and gearing will appreciate that the gear ratio of gears **146** can be adjusted depending upon a desired level of torque delivered to adaptor shaft **82**.

Coupling **142** and equipment mount gear **148** are coupled about adaptor shaft **82**, and in one embodiment include a lubricated and sealed bearing surface configured to align adaptor shaft **82** relative to housing **80** and to permit rotation of adaptor shaft **82**.

In addition, adaptor shaft housing **80** includes a flange **160** configured to couple to flange **126** of head shaft **72** (FIG. **4**). In one embodiment, flange **160** includes bolt holes configured to receive bolts (not shown) inserted into bolt holes formed in flange **126**. In another embodiment, flange **160** is permanently attached to flange **126**, for example by welding. In an exemplary embodiment, each of the flanges **126**, **160** are flat, four-bolt flange bearings, although other forms of flanges **126**, **160** are also acceptable.

FIG. **6**A illustrates an equipment mount adaptor **170** coupled to adaptor shaft **82** according to one embodiment of the present invention. Equipment mount adaptor **170** extends from equipment mount **90** to secure a transmission **172** (or transmission case) to equipment handling apparatus **20**. In one embodiment, transmission **172** is a large transmission, such as a truck transmission, and equipment mount adaptor **170** is configured to attach the large transmission to equipment mount **90**.

In particular, transmission **172** includes a first side **174** and an opposing second side **176**, where the sides **174**, **176** are separated along a longitudinal axis of transmission **172**. Equipment mount adaptor **170** includes a first mount **184** coupled between the first side **174** of transmission **172** and equipment mount **90**, and a second mount **186** coupled between the second side **176** of transmission **172** and the adaptor shaft **82**. In one embodiment, equipment mount adaptor **170** is rigidly coupled to adaptor shaft **82** such that a rotation of adaptor shaft **82** rotates the transmission **172** about the axis defined by shaft **82**. Equipment mount adaptor **170** is preferably coupled to transmission **172** to provide unobstructed access to ends of transmission **172**.

FIG. **6**B illustrates another equipment mount adaptor **190** coupled between adaptor shaft **82** and a small transmission **192** according to one embodiment of the present invention. In this regard, small transmission **192** (for example, a front wheel drive transmission) is non-symmetrical, and equipment mount adaptor **190** is configured to couple one end of the non-symmetrical small transmission **192** to the adaptor shaft **82**.

For example, equipment mount **90** extends from adaptor shaft **82** to one end **194** of small transmission **192**, and equipment mount adaptor **190** extends between an end **196** of adaptor shaft **82** to an end **198** of small transmission **192**. In one embodiment, equipment mount adaptor **190** is rigidly attached between adaptor shaft **82** and the small transmission **192**, such that a rotation of adaptor shaft **82** results in a rotation of small transmission **192** about the axis defined by shaft **82**.

Equipment mount adaptors **170**, **190** are configured to couple to any one of a truck transmission, an automobile transmission, a front wheel drive transmission, or an automotive engine, depending upon the repair situation.

FIG. **7**A illustrates equipment handling apparatus **20** coupled to a transmission placed on a floor according to one embodiment of the present invention. With additional reference to FIG. **6**A, equipment mount adaptor **170** is rigidly coupled between adaptor shaft **82** and transmission **172**. Equipment head **26** has been translated along mast **24** to a position adjacent to the floor, thus also positioning mounting device **28** adjacent to the floor and to transmission **172**. In contrast to other known equipment stands, equipment head **26** of equipment handling apparatus **20** (or stand **20**) is suited for reaching to equipment placed on a floor, in addition to equipment mounted to an automobile chassis. As a point of reference, a "front" of transmission **172** is labeled.

FIG. **7**B illustrates equipment handling apparatus **20** lifting transmission **172** above the floor according to one embodiment of the present invention. In particular, a drive device, for example a hand drill, has been employed to move winch drive **94** (FIG. **1**) in lifting equipment head **26** (not visible) and mounting device **28** upward along mast **24** in lifting transmission **172** above the floor. In this regard, the front face of transmission **172** is visible.

FIG. **7**C illustrates a rotation of mounting device **28** relative to equipment head **26** according to one embodiment of the present invention. A drive device, such as a hand drill, has been employed to turn equipment head drive **96** of motive means **30** (FIG. **3**) such that head shaft **72** (not shown) has been rotated by approximately 45 degrees clockwise about an axis into the paper in the view of FIG. **7**C. In this regard, mounting device **28** has been likewise rotated by approximately 45 degrees clockwise such that transmission **172** has also rotated about an attachment point, and the front of the transmission is visible (as indicated). For example, since transmission **172** is rigidly attached to shaft **82** via equipment mount adaptor **170**, and head shaft **72** is coupled to mounting device **28**, a rotation of mounting device **28** also rotates transmission **172** about the axis defined by head shaft **72**. In other words, transmission **172** is rigidly mounted to adaptor shaft **82** via equipment mount adaptor **170**, such that transmission **172** rotates about the Z-axis (FIG. **2**) along with mounting device **28** to an orientation where a longitudinal axis of transmission **172** is disposed approximately 45 degrees from the horizontal. As a point of reference, mounting device **28** can be translated along mast **24** (up or down, as described above) to provide improved access by a mechanic to transmission **172**.

FIG. **7**D illustrates a rotation of adaptor shaft **82** about a third axis that is, for example, substantially perpendicular to an axis aligned with head shaft **72** (See FIG. **2**) according to one embodiment of the present invention. A drive device, such as a hand drill, has been employed to turn mounting device drive **98** that in turn has rotated adaptor shaft **82** about its axis as illustrated. In this regard, FIG. **7**D illustrates a rotation of about 180 degrees of the transmission **172** about its lateral axis from a lower left hand corner of FIG. **7**D to an upper right hand corner of FIG. **7**D such that a "back" of the transmission **172** case is now visible. In particular, an orientation of mounting device **28** relative to equipment head **26** has been maintained between FIG. **7**D and FIG. **7**C; however, adaptor shaft **82** has been rotated by approximately 180 degrees such that transmission **172** rotates out of the plane of the paper of FIG. **7**D, rotating from the front side to the back side about the axis of shaft **82**.

As a point of reference, FIGS. **7**C and **7**D illustrate adaptor shaft **82** oriented at approximately 45 degrees from a vertical orientation in order to best illustrate a location and function of other components of stand **20**. However, as described above, mounting device **28** that maintains shaft **82** can be rotated 360 degrees via a rotation of shaft **72**, such that adaptor shaft **82** can occupy any desired orientation relative to a vertical orientation. Thus, while FIGS. **7**C and **7**D illustrate a rotation of adaptor shaft **82** about a third axis that rotates work piece **172** from a "front" orientation to a "back" orientation where

mounting device **28** is not in a vertical alignment, it is to be understood that for certain applications, for example when handling heavy work pieces, an orientation of adaptor shaft **82** in a vertical position is preferred. For example, when handling heavy work pieces, it may be preferred to orient shaft **82** vertically, thereby limiting the forces required to be delivered by motive means **30** to move the work piece and limiting forces that are applied to components of stand **20** and motive means **30** as the work piece is rotated about shaft **82**. In this regard, FIGS. **7**A-**7**D are exemplary depictions of an operation of stand **20**, and are not intended to limit the use and movement of components of stand **20**.

With reference to FIG. **7**A-**7**D, equipment stand **20** provides mast **24** aligned along a first axis (the Y-axis in FIG. **2**); an equipment head **26** coupled to and translatable along the mast **24**, where the equipment head **26** includes head shaft **72** that is rotatable about a second axis (the Z-axis in FIG. **2**) that is non-parallel to the first axis; and a mounting device **28** coupled to the equipment head **26**, where the mounting device **28** includes shaft **82** that is independently rotatable relative to the shaft **72** such that the shaft **82** is rotatable about a third axis (the My axis in FIG. **2**) that is non-parallel to the second axis. In this manner, and in contrast to known equipment stands, transmission **172** (or another work piece) can be raised and lowered along mast **24**, rotated by 360 degrees about the second axis aligned with head shaft **72**, and rotated by at least 180 degrees about adaptor shaft **82**, to provide full and convenient access to transmission **172**. To provide a safe and rigid orientation of the work piece/transmission **172**, the head shaft **72** and the adaptor shaft **82** are each lockable in a non-rotating state, for example via shaft lock **129** (FIG. **4**) and shaft lock **143** (FIG. **5**), respectively.

Although specific embodiments have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that a variety of alternate and/or equivalent implementations may be substituted for the specific embodiments shown and described without departing from the scope of the present invention. This application is intended to cover any adaptations or variations of the specific embodiments discussed herein. Therefore, it is intended that this invention be limited only by the claims and the equivalents thereof.

What is claimed is:

1. An equipment handling apparatus comprising:

a base and a mast coupled to the base, the mast aligned along a first axis;

an equipment head coupled to and translatable along the mast, the equipment head including a head shaft defining a second axis non-parallel to the first axis;

a mounting device including:

an adaptor shaft housing coupled to the head shaft, the adaptor shaft housing co-axial with and maintaining a second shaft that is rotatable about a third axis non-parallel to the second axis,

a drive assembly coupled to and extending away from an end of the adaptor shaft housing and engaged with the second shaft, the drive assembly offset from and substantially parallel to the head shaft; and

motive means for translating the equipment head, rotating the head shaft, and for rotating the second shaft independent of the head shaft.

2. The equipment handling apparatus of claim **1**, wherein the base contacts a floor, and further wherein the equipment head is translatable along the mast from adjacent the floor to a top of the mast.

3. The equipment handling apparatus of claim **1**, wherein the mast comprises opposing support members and a movable brace extending between the opposing support members, the brace coupled to the equipment head and including a pair of collars, each collar slidably coupled to one of the support members with at least one of the collars lockable relative to one of the support members.

4. The equipment handling apparatus of claim **1**, wherein the equipment head comprises:

a head housing maintaining the head shaft, the head shaft defining a gear end and a flange end, the gear end coupled to the motive means and the flange end coupleable to the mounting device.

5. The equipment handling apparatus of claim **4**, wherein the

adaptor shaft housing is coupled to the flange end of the head shaft and the second shaft extends from the adaptor shaft housing, the adaptor shaft housing rotatable by at least 180 degrees.

6. The equipment handling apparatus of claim **5**, wherein the head shaft and the second shaft may be locked in a non-rotating state.

7. The equipment handling apparatus of claim **1**, wherein the mounting device comprises an equipment mount coupled to a first end of the second shaft and an equipment mount adaptor coupled to an opposing second end of the second shaft, the equipment mount comprising a plate.

8. The equipment handling apparatus of claim **1**, wherein the motive means comprises a winch gear coupled between the mast and the equipment head, and further wherein movement of the winch gear results in movement of the equipment head along the mast.

9. The equipment handling apparatus of claim **1**, wherein the motive means comprises a head gear coupled to the equipment head, and further wherein movement of the head gear results in rotation of the head shaft about its axis.

10. The equipment handling apparatus of claim **1**, wherein the motive means comprises a mounting device drive coupled to the drive assembly, the mounting device drive including an equipment mount gear coupled to the second shaft, and further wherein rotation of the mounting device drive rotates the equipment mount gear which rotates the second shaft.

11. The equipment handling apparatus of claim **1**, wherein the motive means comprises a drive bolt adapted to couple to one of a hand drill, an air wrench, a hand wrench, and a motor, and further wherein movement of the drive bolt results in movement of one of a winch gear coupled between the mast and the equipment head, a head gear coupled to the equipment head, and an equipment mount gear coupled to the mounting device.

12. The equipment handling apparatus of claim **1**, wherein the head shaft is rotatable by 360 degrees about the second axis and the second shaft is rotatable by up to 360 degrees about the third axis.

13. The equipment handling apparatus of claim **1**, wherein the second shaft approximately equal in length to the head shaft, and each of the second shaft and the head shaft is independently lockable in a non-rotating state.

14. The equipment handling apparatus of claim **1**, wherein the second shaft extends through the adaptor shaft housing and the drive assembly.

15. The equipment handling apparatus of claim **1**, wherein the drive assembly includes a chain coupled between a first gear and a second gear attached to the second shaft.

16. The equipment handling apparatus of claim **1**, wherein the drive assembly engages a central portion of the second shaft.

17. An equipment repair stand comprising:

a base and a substantially vertical mast coupled to the base;

an equipment head coupled to the mast and a mounting device coupled to the equipment head, the equipment head including a first shaft defining a gear end coupled to motive means adjacent to the mast and a flange end coupled to a corresponding flange connected to an adaptor shaft housing of the mounting device, the adaptor shaft housing co-axially maintaining a second shaft that is approximately equal in length to the first shaft;

means for translating the equipment head along the mast;

means for rotating the first shaft through a full 360 degrees; and

a drive assembly, for rotating the second shaft, coupled to and extending away from an end of the adaptor shaft housing and engaged with the second shaft, the drive assembly being offset from and substantially parallel to the first shaft.

18. The equipment repair stand of claim **17**, wherein the equipment head comprises:

a head housing coupled to a brace of the mast; and

a head shaft coupled to the head housing and defining a gear end and a flange end opposite the gear end, the flange end adapted to couple to the mounting device.

19. The equipment repair stand of claim **17**, wherein the means for translating the equipment head along the mast comprises a winch including a cable extending between the equipment head and the mast.

20. The equipment repair stand of claim **18**, wherein the means for rotating the first shaft comprises a toothed gear coupled to the gear end of the head shaft.

21. The equipment repair stand of claim **17**, wherein the second shaft defines opposing ends, each end extending from the adaptor shaft housing; and the mounting device comprises an equipment mount coupled to the opposing ends of the second shaft.

22. The equipment repair stand of claim **21**, wherein the drive assembly for rotating the second shaft further comprises a mounting device drive bolt of a drive assembly that is attached to the adaptor shaft housing, the mounting device drive bolt configured to rotate gears disposed within the drive assembly, at least one of the gears disposed about the second shaft.

23. An equipment repair stand comprising:

a base and a substantially vertical mast coupled to the base;

an equipment head coupled to the mast, the equipment head including a rotatable head shaft that is selectively lockable in a non-rotating state;

a mounting device including an adaptor shaft housing coupled to an end of the head shaft, a geared drive assembly coupled to an end of the adaptor shaft housing, an adaptor shaft that extends through the adaptor shaft housing and the geared drive assembly, and a pair of opposing equipment mounts, each equipment mount coupled to an end of the adaptor shaft, the adaptor shaft selectively lockable in a non-rotating state;

wherein the geared drive assembly engages with a central portion of the adaptor shaft and is configured to rotate the adaptor shaft independently of the head shaft.

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